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Seeded Growth of Highly Crystalline Molybdenum Disulphide Monolayers at Controlled Locations CARL NAYLOR, GANGHEE HAN, NICHOLAS KYBERT, JINGLEI PING, A.T. CHARLIE JOHNSON, Univ of Pennsylvania — Various approaches have been demonstrated for growth on insulating substrates of molybdenum disulphide (MoS_2), but to date growth of isolated crystalline flakes has been only at random locations. We have developed a method to obtain MoS_2 flakes in precisely defined locations. By patterning molybdenum source material that acted both as material feedstock and growth seed at predetermined areas across a wafer, we were able to grow isolated flakes of MoS_2 at these locations with micrometre-scale resolution. These MoS_2 flakes are predominantly of monolayer thickness and high material quality, as confirmed by atomic force microscopy, transmission electron microscopy, Raman and photoluminescence spectroscopy. Since the monolayer flakes are isolated and in predetermined locations, fabrication of transistor structures requires only a single lithographic step. Thus we are able to obtain multiple arrays of MoS_2 transistors, that are highly crystalline and monolayer, making this method ideal for large scale production. Device measurements showed a carrier mobility and on/off ratio that exceeded 10 $cm^2V^{-1}s^{-1}$ and 10^6, respectively. This growth technique provides a path for in-depth physical analysis of monolayer MoS_2 as well as fabrication of MoS_2-based integrated circuits.

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